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Calpito et al.

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(54) **METHODS FOR FORMING CONDUCTIVE BUMPS AND WIRE LOOPS**

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(51) **Int. Cl.**
B23K 31/02 (2006.01)

(52) **U.S. Cl.** **228/180.5**; 228/4.5; 228/110.1

(58) **Field of Classification Search** 228/180.5, 228/4.5
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,205,463 A	4/1993	Holdgrafer et al.		
6,062,462 A	5/2000	Gillotti et al.		
6,156,990 A	12/2000	Ellis		
6,244,499 B1 *	6/2001	Tsai et al.	....	228/180.5
6,270,000 B1 *	8/2001	Nishiura	....	228/180.5
6,715,666 B2 *	4/2004	Imai et al.	....	228/180.5
7,025,247 B2 *	4/2006	Mii et al.	....	228/180.5
2003/0155405 A1 *	8/2003	Takahashi	....	228/180.5
2004/0152292 A1	8/2004	Babinetz et al.		
2004/0164127 A1 *	8/2004	Mii et al.	....	228/180.5

* cited by examiner

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(57) **ABSTRACT**

A method of forming a conductive bump is provided. The method includes depositing a conductive bump on a bonding location using a bonding tool such that a junction exists between (1) a length of wire extending at least partially within the bonding tool and (2) the deposited conductive bump. The method also includes moving the bonding tool to contact the conductive bump such that a location of the junction is moved with respect to the bonding location.

20 Claims, 7 Drawing Sheets

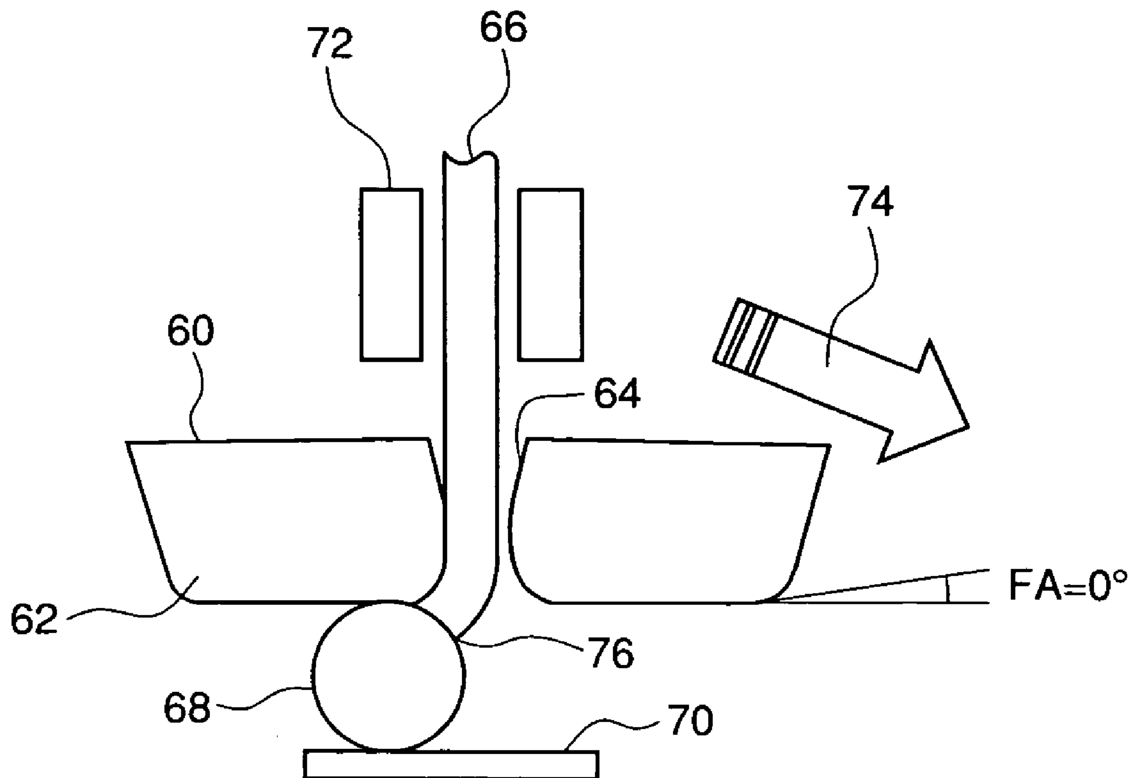


FIG. 1A
(Prior Art)

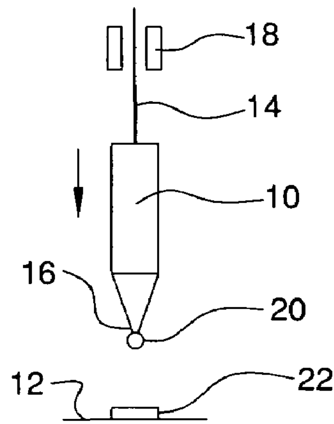


FIG. 1B
(Prior Art)

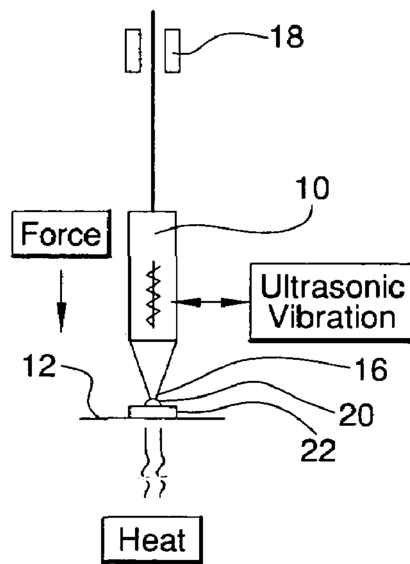
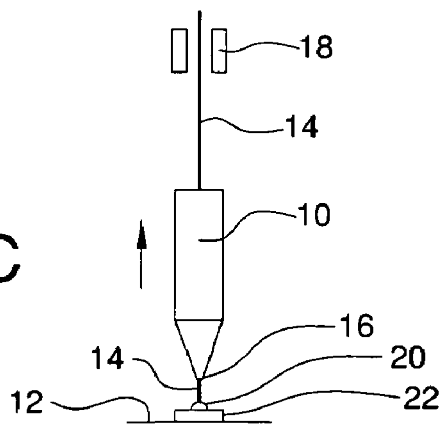


FIG. 1C
(Prior Art)



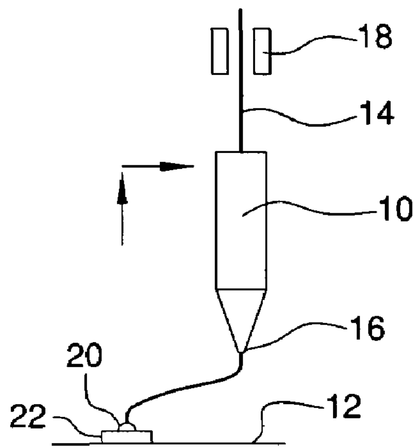


FIG. 1D
(Prior Art)

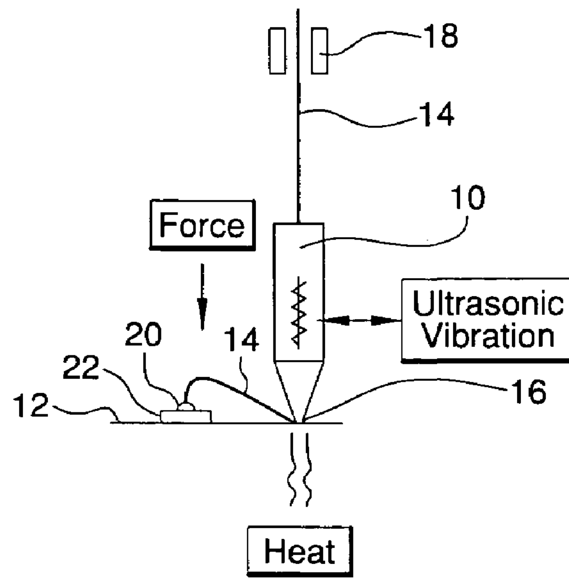


FIG. 1E
(Prior Art)

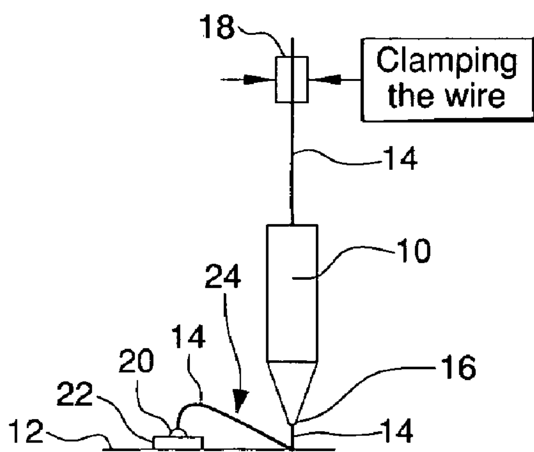


FIG. 1F
(Prior Art)

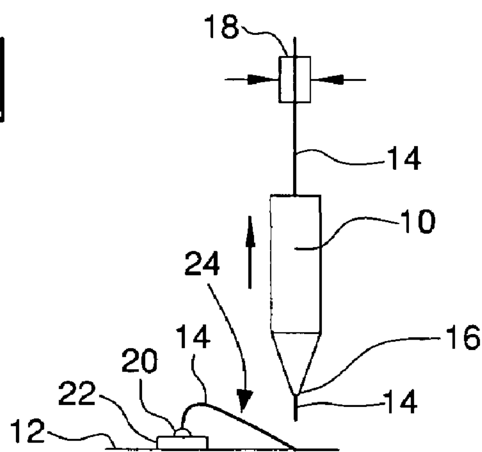


FIG. 1G
(Prior Art)

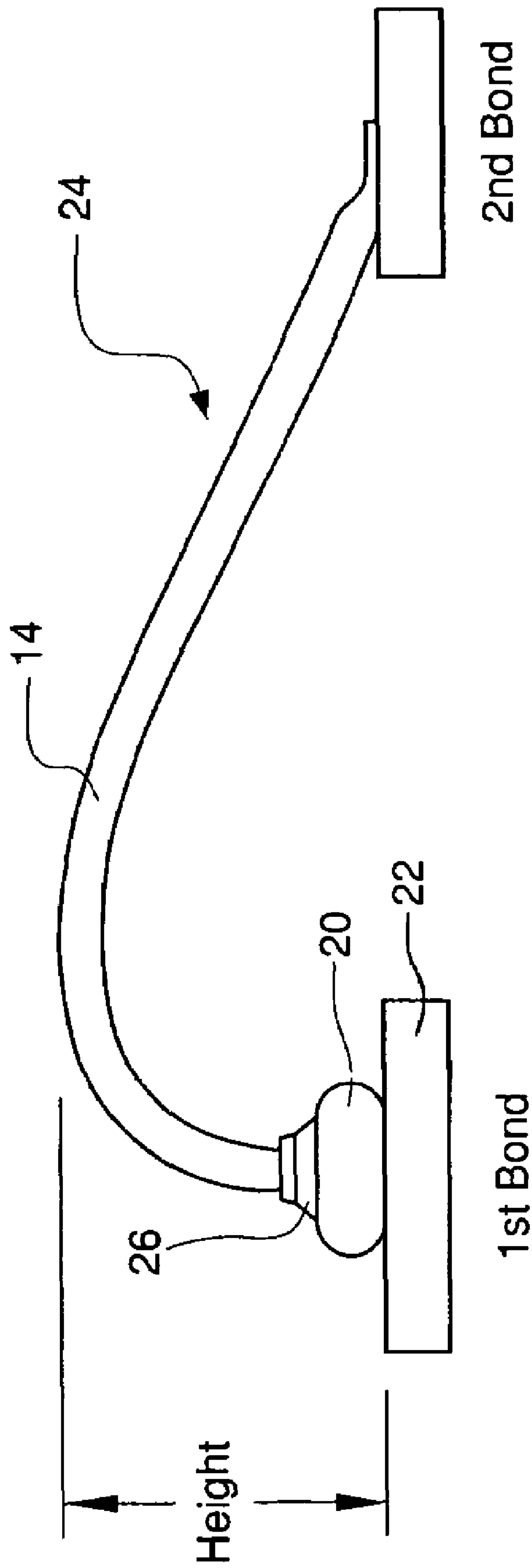


FIG. 2
(Prior Art)

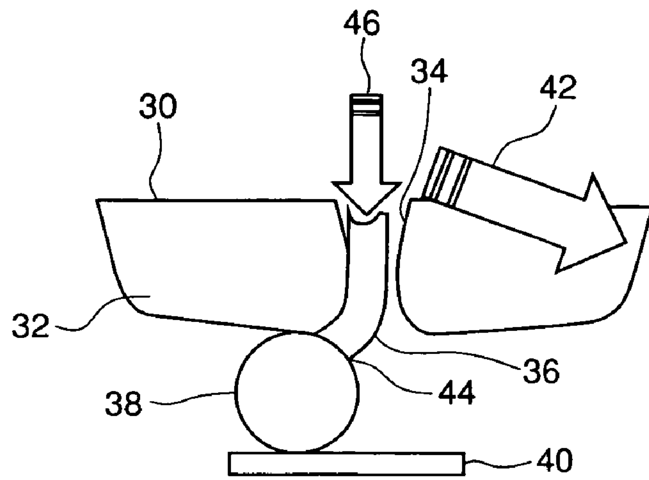


FIG. 3A

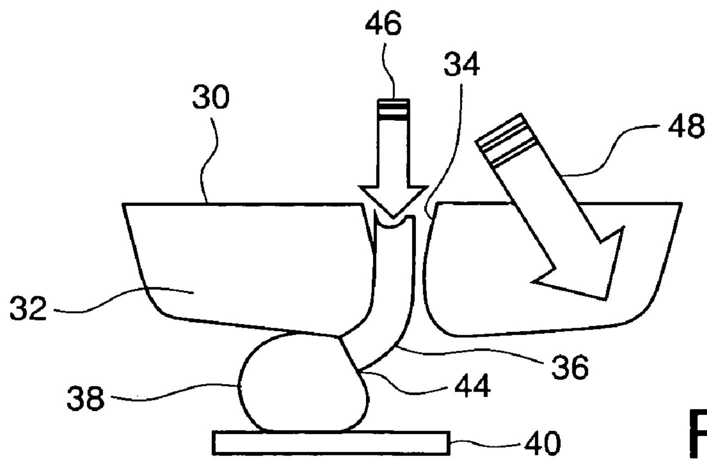


FIG. 3B

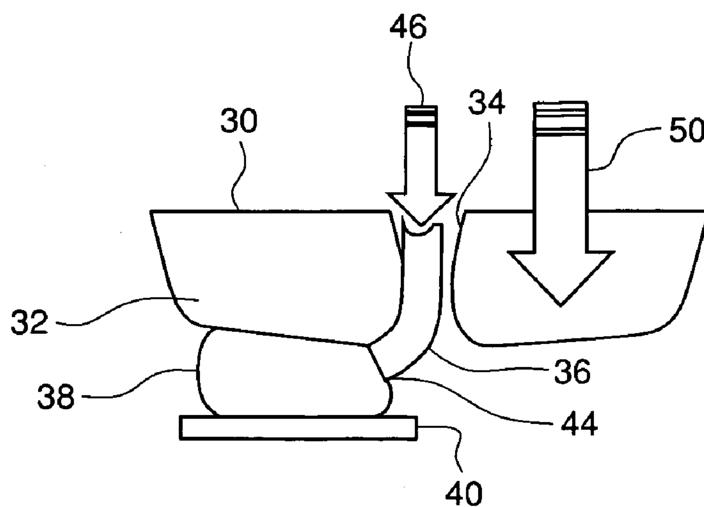


FIG. 3C

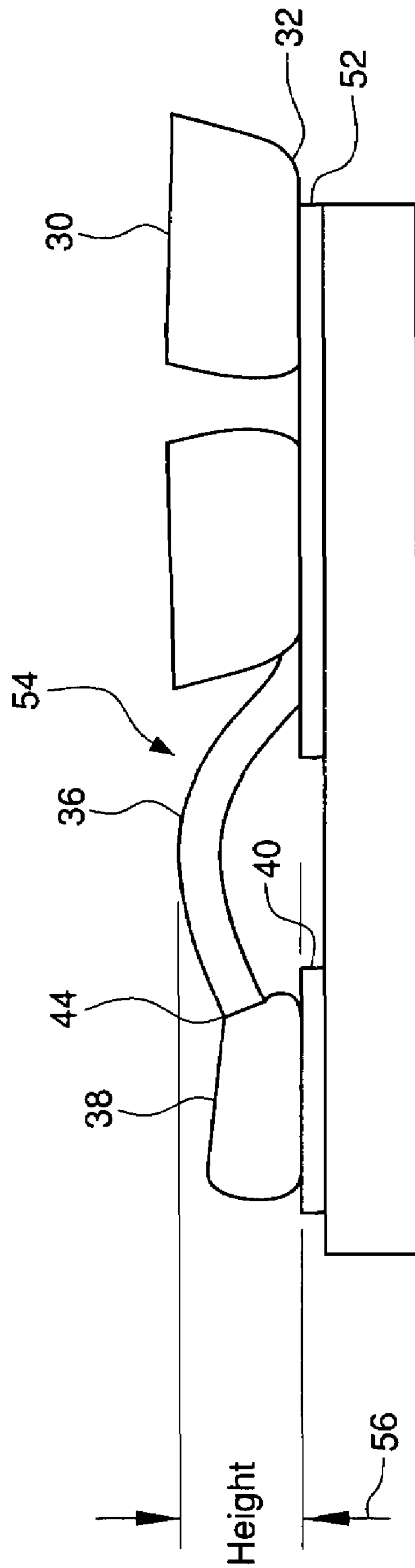


FIG. 4

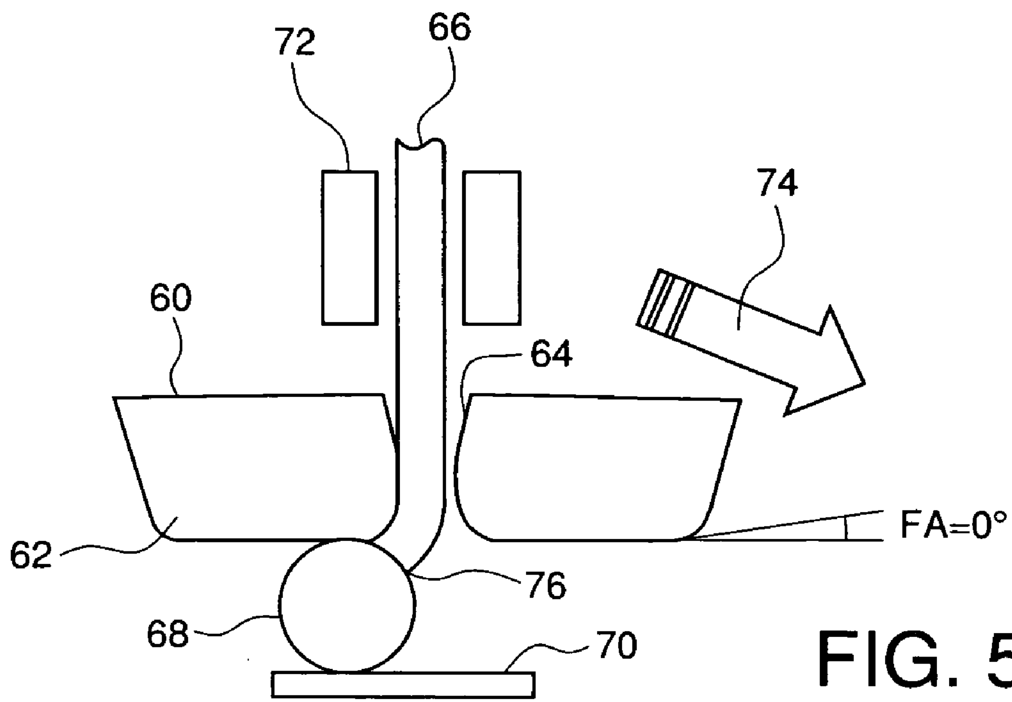


FIG. 5A

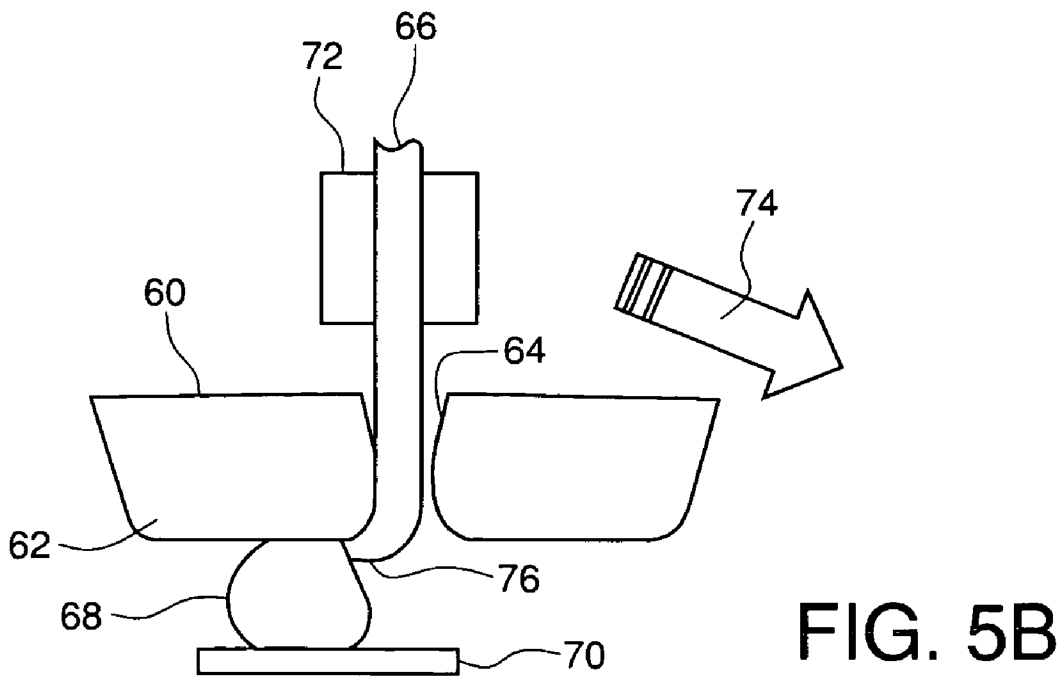


FIG. 5B

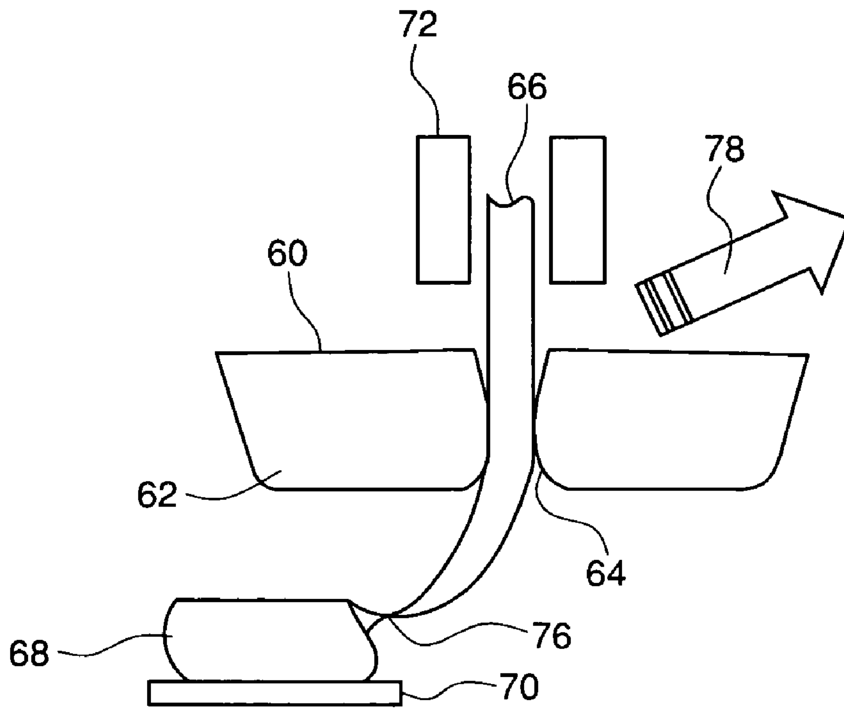


FIG. 5C

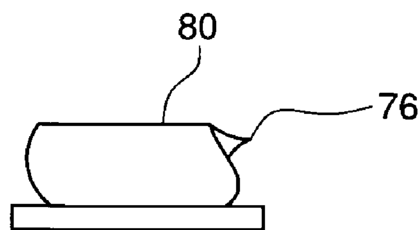


FIG. 6

METHODS FOR FORMING CONDUCTIVE BUMPS AND WIRE LOOPS

RELATED APPLICATION

This application is related to and claims priority from U.S. Provisional Application No. 60/607,888, filed Sep. 8, 2004, which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

The present invention relates to wire bonding, and more particularly, to methods of forming conductive bumps and wire loops.

BACKGROUND OF THE INVENTION

In the electronics industry, conductive wire is used in a variety of devices, such as semiconductor devices for example, to connect portions of the device. Exemplary materials for wire bonding are gold, aluminum, copper and silver. A wire bond is formed by attaching a length of wire between two contact/bonding locations (e.g., a first location being on a semiconductor die, and the second location being on a substrate supporting the die). In order to form the attachment, various devices are used to sever and bond the wire ends to the contact locations. Known wire bonding apparatuses include thermocompression (T/C), thermosonic (T/S) or ultrasonic (U/S) devices. The resulting length of bonded wire is typically curved along its length in a generally parabolic or elliptical configuration and is, therefore, referred to as a wire "loop".

Two known techniques for bonding a wire to a semiconductor device are ball bonding and wedge bonding. Ball bonding is generally the preferred technique, particularly in the semiconductor industry in which more than 90 percent of all semiconductor devices are manufactured using ball bonding.

Referring to FIGS. **1**A through **1**G, there is shown schematically a process of forming a wire loop on a substrate using a known ball bonding technique. The exemplary bonding apparatus includes capillary **10** carried by a bond head (not shown) for movement with respect to substrate **12**. In FIGS. **1**A through **1**G, capillary **10** is illustrated as moving as indicated by the arrows. Although the bonding process is described herein as being accomplished by moving capillary **10**, it should be understood that the desired relative movement between capillary **10** and substrate **12** could also be achieved by moving substrate **12**, or by a combined movement of both capillary **10** and substrate **12**. Capillary **10** defines a central passage in which fine wire **14** is received such that wire **14** is fed from working tip **16** of capillary **10**.

The bonding apparatus also includes clamp **18**, which is carried by the bond head adjacent capillary **10** for preventing relative movement between capillary **10** and wire **14**. Referring to FIG. **1**A, a terminal end portion of wire **14** extending beyond working tip **16** of capillary **10** is formed into substantially spherical ball **20**. Ball bonding apparatuses typically include an electronic flame-off (EFO) wand (not shown) that, when fired, generates a spark that melts the extending end portion of the wire. As the molten end portion of the wire solidifies, surface tension forms the end portion into a substantially spherical configuration, which is sometimes referred to in the art as a "free-air ball." Ball **20** is bonded to substrate **12** (i.e., a bonding location of substrate **12** such as a contact pad of substrate **12**) by the bonding apparatus as described below.

As shown in FIG. **1**B, with clamp **18** open, capillary **10** is directed downwardly until ball **20** touches contact **22** on substrate **12**. Compressive force is then applied to ball **20** by working tip **16** of capillary **10** while heat and vibration is applied by the bonding apparatus. The combined effects of the compressive force, heat and vibration flattens the ball **20** and bonds ball **20** to contact **22** through interfacial interaction between ball **20** and contact **22**.

Referring to FIG. **1**C, capillary **10** is then moved vertically away from contact **22** with clamp **18** in an opened condition such that wire **14** is fed from working tip **16** of capillary **10**. As shown in FIG. **1**D, a horizontal component is then added to the movement of capillary **10** to direct capillary **10**, and wire **14** is fed from capillary **10**, to a second bond location on substrate **12**. Capillary **10** is then moved into contact with substrate **12** at the second bond location where compressive force, heat and vibration is again applied to bond wire **14** to substrate **12** at the second location, thus forming wire loop **24**.

Referring to FIGS. **1**F and **1**G, capillary **10** is then moved by the bonding apparatus a short distance away from the second location on substrate **12** to feed a terminal end portion of wire **14** from capillary **10**, which will form the free-air ball for the next wire loop. With clamp **18** closed, capillary **10** is then moved further away from substrate **12** such that wire **14** is separated from substrate **12** as shown in FIG. **1**G.

Referring to FIG. **2**, completed wire loop **24** is shown in greater detail. As shown, the above-described bonding process results in a flattening of ball **20** at the first bond location on contact **22**. The capillary of ball bonding apparatuses typically includes chamfered surfaces at the working tip such that substantially conical portion **26** of ball **20** is formed. As described above, capillary **10** of the prior ball bonding apparatus is moved vertically into contact with the first bond location. The movement of the capillary remains vertical (i.e., perpendicular to the bond plane at first contact location) as ball **20** is bonded to contact **22**. As a result, wire **14** of wire loop **24** is located at the top of the ball **20** and extends, initially, upwardly from the top of the ball **20**.

Ball bonding apparatuses are also used to form flat-top bumps, also known as "flip-chip connections." Similar to wire bonding, a ball is formed at the end of the wire and the capillary is moved along a vertical pathway to flatten the ball against a contact surface while heat and vibration are applied. Unlike a wire looping process, however, the capillary is raised from the bonded ball with the clamp closed to separate the wire from the ball. The separation results in a peaked surface at the top of the bonded ball that includes the junction between the ball and the wire. The peaked surface is then subjecting to a "coining" process in which force is applied to flatten the peaked surface to create a smooth top.

It would be desirable to provide a ball bonding process for forming a wire loop having a reduced height compared to wire loops formed by prior ball bonding processes and to provide for a desirably shaped bump without the use of a coining process.

SUMMARY OF THE INVENTION

According to an exemplary embodiment of the present invention, a method of forming a conductive bump is provided. The method includes depositing a conductive bump on a bonding location using a bonding tool such that a junction exists between (1) a length of wire extending at

least partially within the bonding tool and (2) the deposited conductive bump. The method also includes moving the bonding tool to contact the conductive bump such that a location of the junction is moved with respect to the bonding location.

According to another exemplary embodiment of the present invention, a method of forming a wire loop extending between a first bonding location and a second bonding location is provided. The method includes depositing a conductive bump on a first bonding location using a bonding tool such that a junction exists between (1) a length of wire extending at least partially within the bonding tool and (2) the deposited conductive bump. The method also includes moving the bonding tool to contact the conductive bump such that a location of the junction is moved with respect to the bonding location. The method also includes moving the bonding tool towards a second bonding location while paying out wire through the bonding tool. The method also includes forming a wire bond at the second bonding location, such that a wire loop extends between the first bonding location and the second bonding location.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is best understood from the following detailed description when read in connection with the accompanying drawing; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown. It is emphasized that, according to common practice, the various features of the drawing are not to scale. On the contrary, the dimensions of the various features are arbitrarily expanded or reduced for clarity. Included in the drawing are the following figures:

FIGS. **1**A through **1**G are schematic illustrations of a prior art ball bonding process.

FIG. **2** is an illustration of a prior art wire loop formed by the ball bonding process of FIGS. **1**A through **1**G.

FIGS. **3**A through **3**C are schematic illustrations of a ball bonding process according to an exemplary embodiment of the present invention.

FIG. **4** illustrates a wire loop according to an exemplary embodiment of the present invention formed using the ball bonding process of FIGS. **3**A through **3**C.

FIGS. **5**A through **5**C are schematic illustrations of a ball bonding process according to an exemplary embodiment of the present invention.

FIG. **6** is a rolled bump formed by the process of FIGS. **5**A through **5**C.

DETAILED DESCRIPTION OF THE DRAWINGS

U.S. Pat. Nos. 5,205,463, 6,062,462, and 6,156,990, as well as U.S. patent Publication No. 2004/0152292, relate to wire bonding technology, and are herein incorporated by reference in their entirety.

As used herein, the term "bonding location" refers to any of a number of locations used to deposit (e.g., ball bond) a conductive bump, or to bond an end of a wire loop. For example, a bonding location may be a conductive region of a substrate (e.g., a contact pad of the substrate, a terminal of the substrate, a conductive trace of the substrate, etc.). Other exemplary bonding locations include conductive regions of a semiconductor device (e.g., a contact pad of a semiconductor die, etc.).

According to certain exemplary embodiments of the present invention, a ball bonding process is provided for bonding a wire ball to a bonding location (e.g., a conductive region of a substrate, a conductive region of an integrated circuit device, etc.). A ball bonding apparatus includes a bonding tool (e.g., a capillary) defining a central passage for receiving a length of wire such that the wire extends from a working tip of the capillary. A substantially spherical ball is formed from an end portion of the wire, preferably by directing a spark to the wire from an EFO wand.

The capillary is directed towards the bonding location until the ball touches the surface of the bonding location. The capillary is then moved by the ball bump apparatus along a downwardly oblique pathway with respect to the surface of the bonding location such that a rolling motion is imparted to the ball by a horizontal component of the capillary movement as the vertical component of the capillary movement flattens the ball. The rolling motion imparted to the ball as it is bonded to the surface of the bonding location relocates the junction between the wire and the ball from the top of the ball to one side of the ball.

According to certain exemplary embodiments of the present invention, the ball bonding apparatus is used to form a wire loop. As the ball is being rolled by the obliquely moving capillary, the vertical component of the capillary motion is increased until the capillary is moved along a substantially vertical path with respect to a first bonding location. The ball is rolled and bonded to the first bonding location while the clamp is held in an opened condition allowing relative movement between the wire and the capillary. For example, heat and vibration may be applied by the ball bonding apparatus to facilitate bonding between the ball and the first bonding location. After the ball has been bonded to the first bonding location, the capillary is directed away from the first bonding location to a second bonding location while the clamp is held opened to feed wire from the capillary. The wire is then bonded to the second bonding location by the capillary to form a wire loop.

According to certain exemplary embodiments of the present invention, a ball bonding apparatus is used to form a conductive bump on a bonding location. The capillary of the ball bump apparatus includes a working tip having a face angle that is equal to approximately zero degrees. The capillary is moved towards the bonding location until the wire ball touches the surface of the bonding location. The capillary is then moved along a downwardly oblique path with respect to the bonding location such that a horizontal component of the motion imparts a rolling motion to the ball while a vertical component flattens the ball. The rolling motion imparted to the ball relocates the junction between the wire and the ball from the top of the ball to one side of the ball.

In contrast to the certain other exemplary embodiments of the present invention (e.g., certain of the methods of forming wire loops), the clamp of the ball bonding apparatus is closed during the rolling of the ball such that the diameter of the wire is reduced at the junction between the wire and the ball. The reduction in the diameter of the wire weakens the wire at the junction, such that movement of the capillary away from the bonded ball with the clamp in an opened condition results in separation between the wire and the bonded ball bump as a short length of wire is fed from the working tip of the capillary.

Referring to the drawings, where like numerals identify like elements, there is illustrated in FIGS. **3**A through **3**C a ball bonding process according to an exemplary embodiment of the present invention. As described below, the ball bonding process of the present invention provides a bonded wire loop that extends to a height from the underlying

substrate to which it is bonded that is reduced compared to that of wire loops formed by prior ball bonding processes.

Referring to FIG. 3A, a ball bonding apparatus includes a bonding tool **30** (e.g., a capillary **30**) having working tip **32**. To facilitate illustration of the invention, only working tip **32** of capillary **30** is shown. Capillary **30** defines central passage **34** that extends through capillary **30** and that receives wire **36** for bonding by the ball bonding apparatus. In a known manner, substantially spherical ball **38** is formed from a terminal end portion of wire **36** that extends from capillary **30** beyond working tip **32**. Preferably, the ball bonding apparatus includes an electronic flame-off (EFO) wand (not shown) that generates a spark to melt the metal of wire **36** and form ball **38** at the end of wire **36**.

Capillary **30** is directed (in the direction indicated by arrow **46** in FIG. 3A) by the ball bonding apparatus towards a bonding location (e.g., a contact pad of a substrate, a contact pad of a semiconductor die, etc.) until ball **38** touches first contact **40**. As indicated by arrow **42** in FIG. 3A, capillary **30** is then directed along an oblique pathway (i.e., in an angular direction) with respect to the surface of first contact **40** such that a rolling motion is applied to ball **38**. This contrasts with motion of conventional wire bonding processes where the movement of the capillary after the first ball is placed is generally perpendicular to the initial contact surface. As a result of the rolling motion that is imparted to ball **38**, junction **44** between wire **36** and ball **38** is relocated from the top of ball **38** to a location along the side of ball **38**.

According to certain exemplary embodiments of the present invenion, the ball bonding apparatus includes a clamp that, similar to the clamps of prior ball bonding apparatuses, prevents relative movement between capillary **30** and wire **36** when the clamp is in a closed condition. As indicated in FIGS. 3A–3C by arrow **46**, the clamp of the ball bonding apparatus is maintained in an opened condition as ball **38** is rolled by the obliquely moving capillary **30**.

Referring to FIG. 3B, as junction **44** between wire **36** and ball **38** is relocated from the top of ball **38** by the obliquely moving capillary **30**, the path of capillary **30** may be changed. As indicated by arrow **48** in FIG. 3B, the vertical component of the movement of capillary **30** is increased. As shown in FIG. 3B, the increasingly vertical movement of capillary **30**, and the corresponding reduction in the distance between working tip **32** and first contact **40**, results in flattening of ball **38**. As also shown in FIG. 3B, there is still a horizontal component to the movement of capillary **30** further rolling ball **38** and relocating junction **44** between wire **36** and ball **38** away from a top location such that junction **44** is located along a side of ball **38**. As indicated by arrow **46**, the clamp of the ball bonding apparatus preferably remains in an opened condition permitting relative movement between wire **36** and capillary **30**.

Referring to FIG. 3C, with ball **38** rolled such that junction **44** has been relocated substantially to the side of ball **38**, capillary **30** is preferably moved towards first contact **40** along a path that is substantially vertical (i.e., perpendicular to the surface of first contact **40** as indicated by arrow **50**) to apply a compressive force to ball **38**. As shown in FIG. 3C, the compressive force results in further flattening of ball **38**. For example, heat and vibration may be applied by the ball bonding apparatus to facilitate bonding between ball **38** and first contact **40**. It should be readily apparent that depending on the degree of vertical movement provided during the step shown in FIG. 3B, the movement of capillary **30** shown in FIG. 3C may be eliminated.

Referring to FIG. **4**, capillary **30** is then moved to second bond location **52** with the clamp in the opened condition such that wire **36** is fed from working tip **32** of capillary **30**. Force, heat and vibration are then applied by the ball bonding apparatus to bond wire **36** to second bond location **52** and form wire loop **54**. Wire **36** of wire loop **54** extends to height **56** with respect to the surface of first contact **40** to which ball **38** is bonded. Because the above-described rolling of ball **38** locates junction **44** on the side of ball **38**, instead of the top of the ball, height **56** is less than that of prior wire loops in which the wire extends upwardly from the top of the ball.

Referring to FIGS. 5A through 5C, there is illustrated a ball bonding process according to the invention for forming a bump (e.g., a flat-top bump). Flat-top bumps may also be referred to in the art as “flip-chip connections.” Ball bump flip-chip connections are used, instead of wire connections, in applications where demands for smaller packaging, such as in the cellular telephone market, may rely on increased density of the bond connections. In addition to compactness in design, flip-chip connections may also provide improved electrical performance through reduced interconnect length.

Similar to the above-described ball bonding apparatus of FIGS. 3A through 3C, the ball bump apparatus of FIGS. 5A through 5C includes capillary **60** having working tip **62** and central passage **64** receiving wire **66**. As shown, working tip **62** differs from working tip **32** of FIGS. 3A through 3C in that working tip **62** has a face angle substantially equal to zero.

Referring to FIG. 5A, substantially spherical ball **68** is formed from an end portion of wire **66** extending from working tip **62**. Capillary **60** is directed by the ball bonding apparatus towards bonding location **70** (e.g., a contact **70** on a substrate) until ball **68** touches contact **70**. With clamp **72** in an opened condition, capillary **60** is directed along an oblique or angular pathway with respect to the surface of contact **70**, shown by arrow **74**, imparting a rolling motion to ball **68**. Similar to the above-described ball bonding process, the rolling motion of ball **68** provided by the oblique motion of capillary **60** relocates junction **76** between wire **66** and ball **68** from the top of ball **68** to the side of ball **68**.

Referring to FIG. 5B, clamp **72** is closed to prevent relative movement between capillary **60** and wire **66**. Capillary **60** continues to be moved along oblique path **74** with clamp **72** held in the closed condition. This differs from the above-described ball bonding process in which, as shown in FIG. 3B, the clamp is maintained in an opened condition and the angle of the capillary is changed to increase the vertical component of movement with respect to the contact surface. As shown in FIG. 5B, the vertical component of capillary movement along path **74** results in flattening of ball **68**. As also shown, the horizontal component of capillary movement along path **74** with clamp **72** held in the closed condition results in reduction in the diameter of wire **66** at junction **76**. For example, heat and vibration may be applied to ball **68** as it is being flattened under pressure by capillary **60** to facilitate bonding between ball **68** and contact **70**.

Referring to FIG. 5C, clamp **72** is opened after ball **68** has been bonded to contact **70** and wire **66** has been reduced in diameter at junction **76**. Capillary **60** is then moved away from contact **70** a short distance along upwardly extending pathway **78**. As shown, the reduced diameter of wire **66** at junction **76** remains sufficiently intact for a short length of wire **66** to be fed from working tip **62** of capillary **60**. As shown in FIG. 5C, however, the horizontal component of the capillary movement along path **78** results in further reduction in the diameter of wire **66** at junction **76** until separation occurs between wire **66** and ball **68**.

Referring to FIG. **6**, an exemplary flat-top bump **80** that results from separation between wire **66** and bonded ball **68** is shown. The above-described rolled ball process for forming ball bump **80** provides a simplified process compared to prior ball bump processes. In prior processes, the ball is flattened under pressure applied by a vertically moving capillary and bonded to a substrate surface using heat and vibration. Because of the vertical pathway of the capillary (i.e., no horizontal rolling component to the capillary movement), the junction between the wire and the bonded ball remains at the top of the ball following bonding of the ball. Following separation between the wire and the bonded ball, by upwardly moving the capillary when the clamp is held in its closed condition for example, leaves a peak at the top of the ball that includes the wire junction. In order to provide a flat-top ball bump, conventional processes may utilize a further step known as "coining" which involves applying force to the top of the bonded ball to flatten the peak into a smooth surface.

The rolling of the ball during the bonding step of the ball bump process of the present invention relocates the wire junction at the side of bonded ball **68**. Furthermore, by providing working tip **62** of capillary **60** with a face angle substantially equal to zero, working tip **62** forms the top of bonded ball **68** into a smooth, flat, surface. Therefore, the ball bump process of the present invention may eliminate the subsequent "coining" of bonded ball **68**.

While the present invention has been described primarily with respect to a ball-shaped or spherical conductive bumps being deposited, it is understood that the conductive bumps are not limited to any particular size, shape, or configuration.

Although the invention is illustrated and described herein with reference to specific embodiments, the invention is not intended to be limited to the details shown. Rather, various modifications may be made in the details within the scope and range of equivalents of the claims and without departing from the invention.

What is claimed:

1. A method of forming a conductive bump, the method comprising the steps of:

depositing a conductive bump on a bonding location using a bonding tool such that a junction exists between (1) a length wire extending at least partially within the bonding tool and (2) the deposited conductive bump, the depositing step including lowering the bonding tool such that the conductive bump is deposited on the bonding location; and

moving the bonding tool to contact the conductive bump such that a location of the junction is moved with respect to the bonding location, the moving step including moving the bonding tool to contact the conductive bump after the depositing step, where the bonding tool is not raised between the depositing step and the moving step.

2. The method of claim **1** wherein the moving step includes moving the bonding tool at an oblique angle with respect to the bonding location.

3. The method of claim **1** wherein the moving step includes at least partially flattening the deposited conductive bump such that a height profile of the conductive bump is decreased.

4. The method of claim **1** wherein the moving step includes at least partially flattening the deposited conductive bump such that a top surface is substantially flat.

5. The method of claim **1** wherein the moving step includes at least partially flattening the deposited conductive bump with the bonding tool, where the bonding tool has a face angle of substantially zero degrees.

6. The method of claim **1** further comprising separating conductive bump from the length of wire.

7. The method of claim **6** wherein the separating step includes moving the bonding tool away from the conductive bump, with a clamp engaged with the bonding tool in a closed position, to separate the conductive bump from the length of wire.

8. The method of claim **1** further comprising (a) moving the bonding tool towards a second bonding location while paying out wire through the bonding tool, and (b) forming a wire bond at the second bonding location after step (a), such that a wire loop extends between the bonding location and the second bonding location.

9. A method of forming a conductive bump, the method comprising the steps of:

depositing a conductive bump on a bonding location using a bonding tool such that a junction exists between (1) a length wire extending at least partially within the bonding tool and (2) the deposited conductive bump; and

moving the bonding tool to contact the conductive bump such that a location of the junction is moved with respect to the bonding location, wherein the moving step includes moving the junction from (a) an area at an upper portion of the conductive bump with respect to the bonding location to (b) an area at a side portion of the conductive bump with respect to the bonding location, where the bonding tool is not raised between the depositing step and the moving step.

10. The method of claim **1** wherein the moving step includes (a) moving the bonding tool, while in contact with the deposited conductive bump, at an angle extending downward and away from the conductive bump.

11. The method of claim **10** wherein after step (a) the moving step also includes (b) further moving the bonding tool, while still in contact with the deposited conductive bump, at a different angle extending downward and away from the conductive bump.

12. The method of claim **11** wherein after step (b) the moving step also includes (c) further moving the bonding tool, while still in contact with the deposited conductive bump, in substantially downward direction.

13. A method of forming a wire loop extending between a first bonding location and a second bonding location, the method comprising the steps of:

(a) depositing a conductive bump on a first bonding location using a bonding tool such that a junction exists between (1) a length of wire extending at least partially within the bonding tool and (2) the deposited conductive bump, the depositing step including lowering the bonding tool such that the conductive bump is deposited on the first bonding location;

(b) moving the bonding tool to contact the conductive bump after step (a) such that a location of the junction is moved with respect to the bonding location, where the bonding tool is not raised between step (a) and step (b);

(c) moving the bonding tool towards a second bonding location while paying out wire through the bonding tool; and

(d) forming a wire bond at the second bonding location, such that a wire loop extends between the first bonding location and the second bonding location.

14. The method of claim **13** wherein step (b) includes moving the bonding tool at an oblique angle with respect to the bonding location.

15. The method of claim **13** wherein step (b) includes at least partially flattening the deposited conductive bump such that a height profile of the conductive bump is decreased.

16. The method of claim **13** wherein step (b) includes at least partially flattening the deposited conductive bump such that a top surface is substantially flat.

17. A method of forming a wire loop extending between a first bonding location and a second bonding location, the method comprising the steps of:

(a) depositing a conductive bump on a first bonding location using a bonding tool such that a junction exists between (1) a length of wire extending at least partially within the bonding tool and (2) the deposited conductive bump;

(b) moving the bonding tool to contact the conductive bump such that a location of the junction is moved with respect to the bonding location;

(c) moving the bonding tool towards a second bonding location while paying out wire through the bonding tool; and

(d) forming a wire bond at the second bonding location, such that a wire loop extends between the first bonding location and the second bonding location, wherein step (b) includes moving the junction from (1) an area at an upper portion of conductive bump with respect to the first bonding location to (2) an area at a side portion of the conductive bump with respect to the first bonding location.

18. The method of claim **13** wherein the moving step includes (1) moving the bonding tool, while in contact with the deposited conductive bump, at an angle extending downward and away from the conducive bump.

19. The method of claim **18** wherein after step (1) the moving step also includes (2) further moving the bonding tool, while still in contact with the deposited conductive bump, at a different angle extending downward and away from the conductive bump.

20. The method of claim **19** wherein after step (2) the moving step also includes (3) further moving the bonding tool, while still in contact with the deposited conductive bump, in a substantially downward direction.

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